

Resource based Environmental Issues and Sustainability: A Smart Climate Approach for India

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Abstract

The reduction in resource base beyond its regenerating capacity is the scope of the present study. The paper highlights the importance of natural resources and the issues related to land, water, energy and gaseous emissions. It also portrays how the aforementioned issues are inter-related. It clearly delineates the scientific techniques, government initiatives and traditional knowledge which are in practice to reduce the climate crisis and resource depletion. Considering India's ever-growing population, the paper made a good attempt to highlight food security in India, and how food production is associated with GHG emissions. The paper coined a new term – Smart Climate Approach (SCA) as a smarter step to combat climate change while ensuring environmental sustainability. It also provides an idea of greening the institutions via linkages between green museums, green finance, and green GDP which ensures green societies and green economy. The SCA and the linkage model adds up to the novelty of this article. Towards the end, it gives certain policy suggestions like green exhibits, networking green finance, awareness, smart climate activities, and many more, to speed up the process of sustainability, and to achieve the targets set up in our national environmental framework.

Keywords: *Natural resources. Smart Climate Approach. Green Museums. Green Finance. India.*

Introduction

India, the second most populous nation with around 1.3 billion population is high on resource and energy demand. It is also a sub-continent where agriculture happens to be the largest source of livelihood. Geographically located at the heart of Indian Ocean, with diverse ecosystem combining humid and dry tropical climatic factors in the south to temperate alpine in the northern reaches, India attracts prime focus in environmental issues.

Natural resources act as major life enablers. Elements like land, water, air, rainfall, temperature, etc., are appropriately distributed by the nature. But undue disturbances are about to create a havoc. The result of continuous negligence and exploitation of natural resources have become very hostile and create a threat to the future generation (Xiao et al., 2019; Western, 2001). According a study of India, the ecosystem services that water bodies once offered have reduced proportionately, and the 29.14% of land that was converted from other land use types to built-up regions is now unable to provide the

ecosystem services, which is not conducive to a healthy ecosystem (Talukdar et al., 2020). The agricultural challenges in India are divided under three heads: challenge to double farmers' income; boost up the productivity and the challenge associated with exhaustion of natural resources and affected agro-biodiversity.

The increased carbon emission has triggered global action in the form of Sustainable Development Goals (SDGs). Having already set its goals and targets under 'Panchamrit' mission at CoP26 (Glasgow), India is striving towards reliance on cleaner energy. Each and every climate conference and summit give India a chance to move one step closer to its targets. In spite of the obstacles presented by the global health crisis and fluctuations in climate, India exhibited exceptional strength and resilience, playing a crucial role in its economic recovery and growth.

Keeping in view the major environmental issues, the paper defines a new term - 'Smart Climate Approach' as an initiative to put a break on the speed of changing climatic conditions via controlling the indicators governing this phenomenon. Smart Climate Approach (SCA) can be defined as "a technique that combines scientific and traditional methods that utilizes minimum resources while providing maximum output for better and lasting livelihood for human and environment."

It also focuses on the process of greening of institutions from micro to macro level and the linkages among them. It highlights the importance of green museums and green finance in creation of sustainable society and green economy through educating the masses, awareness campaigns, smart climate exhibits, and so on. In the end, the paper gives suggestion to achieve the objectives of Smart Climate Approach. It brings to account locals, students, governing bodies, educationists, scientists, and policymakers to join hands in the

process of sustainability and conservation of our precious environment.

2. Objectives of the study:

- To highlight the environmental resources affecting livelihood.
- To bring out the issues associated with sustainability.
- To bring forth the relation between carbon emissions and food security.
- To underline the scientific techniques and practices for sustainable development.
- To provide policy suggestions and future scope of the study.

3. Research Methodology

The present study utilizes explorative method to delve deeper into resource based sustainability issues to highlight newer perspective. It is descriptive in nature. It also utilizes data for the analysis of relationship between carbon emissions and production indices – CPI, FPI and LPI. The graphical interpretation underlines the significance of sustainable food and issues associated with it. The study explores the relationship between environment and economy via green museums and green finance.

4. Major Environmental Resources that Affect humans

Ecosystems provide for resources which are the lifeline for better sustenance. It comprises land, water, air, energy, food, and other immaterial services like, climate regulation, carbon sequestration, water purification, and aesthetic benefits. According to a report of Millenium Ecosystem Assessment (MEA, 2005), approximately 60 percent of ecosystem services have been degraded which is severely impacting the ecosystem and its services. Limited area of

land is meant to bear the brunt of burgeoning population from providing food and shelter to other amenities.

Further, a vital component of most living things is water, which comprises 71% of the globe. It is crucial to the biological ecosystems and food security of the world. security of human food depends on having access to sufficient agricultural water supplies. It is another essential resource in electricity production and used as coolants in industrial production processes. India, following China as the world's second biggest coal producer, relies heavily on coal for energy and electricity generation. India, which is ranked as world's third-largest user of oil and electricity, began installing renewable energy projects in the 1980s and now holds fourth position for total installed capacity.

Howsoever, given the resources and their increasing usage, comes up the issue of sustainability, evolved from the Brundtland Report (1987) '*Our Common Future*'. Development with sustainability is the call round the globe, including India. The following section mentions the environmental issues which hampers the ways towards a sustainable India.

5. Environmental Issues associated with sustainability

The environmental issues associated with sustainability are inter-connected in nature.

Increased economic and productive activities, ultimately requires land, water and energy majorly, which adds up to the emission levels. The increased gaseous emissions in turn affects production and productivity of agricultural sector. The following diagram depicts how each issue overlaps the other and creates a chain effect on each other.

The figure 1 shows the interconnected environmental issues which includes, land related, water related, energy related and emission related issues.

5.1. Land-related issues

Land comprises 29 % of the globe's area. Ever increasing population creates demand food, amenities, and so on. This creates an indirect demand for industrialization, urbanization, and increased production to meet the needs. Over pressurizing the limited land area has repercussions in various forms, like disasters, emissions, etc. In India, the speedy growth in population has culminated into the rise of new settlements and urban sprawl, causing severe changes in land use and land cover. Many productive agricultural lands, forests, grasslands, and water bodies have been converted into industrial, residential and commercial areas, which are unable to supply services they were meant for. Further, a new issue of Urban Heat Islands has come up with increased urbanization and compact building set ups.

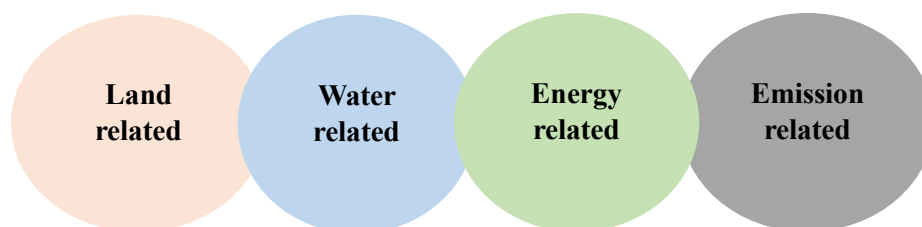


Figure 1 Interconnected environmental issues (Source: Authors' preparation)

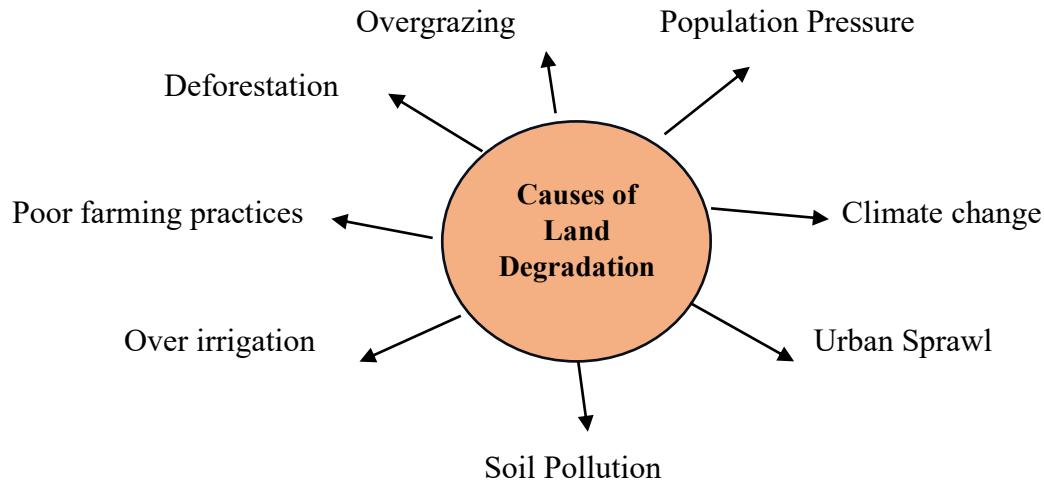


Figure 2 Causes of land degradation (Source: Authors' preparation)

The figure 2 shows the causes of land degradation which includes, overgrazing, population burden, climate change, soil degradation, urban sprawl, over irrigation, poor farming practices and deforestation.

5.2. Water-related issues

Groundwater is essential as a primary source of drinking water, valuable natural resource, and crucial for the survival of all living organisms on the planet. Because of slow recharging of specific groundwater aquifers, the average time could take hundreds, thousands or even millions of years. In addition to other factors, climate change is also an important factor in putting pressure on the natural replenishment of groundwater in terms of time, intensity, and chemical pollution. Severe weather condition like hurricanes in tropical regions, floods, dry spells, and rising temperature as a result of climate change have placed significant stress on water resources and their accessibility. Additionally, it has put the supply of water in surface water reservoirs at risk, particularly during the irrigation season due to heightened need for crop growth (Vano et al. 2010; Malek et al. 2018; Michalak 2020). The

main effects of climate change, such as flooding in plain areas and drought, impact the quality and availability of water by altering the concentration of dissolved (Srivastav et al., 2021).

5.3. Energy Issues

India is high on energy demand, which has become an essential element in each and every process. Around 80 % of its energy requirement is met by non-renewable energy source, namely coal. The undesirable consequences of usage fossil fuels, such as emission of greenhouse gases (GHG), global warming and climate change has led to rapid expansion of renewable energy technologies globally. In order to lower down the increasing GHG emissions, switch over to non-conventional energy sources and application of electric transportation are contemplated as prompt steps. India has established an intimidating target of 450 GW renewable energy capacity by 2030 to demonstrate its dedication to sustainable development (R et al., 2022).

5.4. Gaseous emissions

The primary challenge in the utilization of conventional fuel is its irreparable harm to the environment. The release of catastrophic gases like carbon dioxide, methane, sulphur oxides, nitrogen oxides etc., result into acid rain, global warming and climate change. The non-conventional energy sources like hydro, wind, solar and biomass safeguards against economic and environmental issues, and thereby provide energy security. India's profile of carbon emission proposes the doubling of energy efficiency in order to attain the target of net-zero emission by the year 2070 (Uche et al., 2023).

6. Sustainable Food

Based on our third objective, the paper made a good attempt to highlight food security in India, and how food production is associated with GHG emissions. Given that India is predominantly an agriculture-based economy, with over 50% of its population involved in the agricultural sector, food production emerges as a critical economic activity that is susceptible to the impacts of climate change. Feeding such a vast population

with sustainable practices creates a challenge for the world's third largest growing economy (FAO, 2024). Various type of production activities, including production process, distribution, and high-end energy usage in this process has scaled up the gaseous emission level over the years, round the globe. India is among one of the fastest growing economies with exponential population growth rate, gearing up attention to ensure food security with sustainable and resilient techniques. Amongst all these issues, carbon emission has become a global burden. Maintaining a nexus between food security and CO₂ emission appears as a bigger challenge on the screen as a measure to combat climate change.

SDG 2 aims to end hunger, attain food security and improved nutrition, and encourage sustainable agriculture by 2030. According to World Bank, agricultural land is 60% in 2021 in India. In the fiscal year 2023, total food grain production reached 329.7 million tons, an increase of 14.1 million tons from the previous year. Cereals cover nearly about 54% of total production in India. The global food system which includes, production, processing and distribution, constitutes for about one-third of total global GHG emissions.

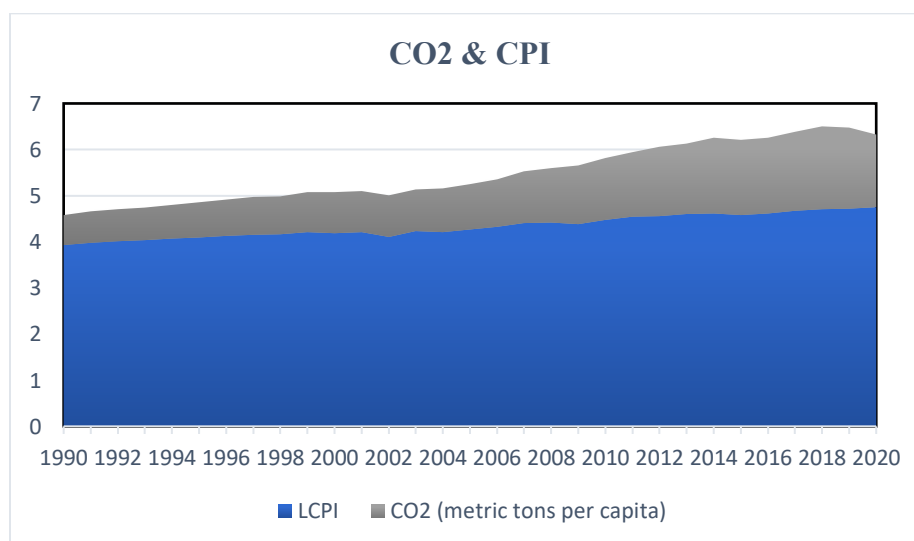


Figure 3(a) Carbon emissions and crop production index

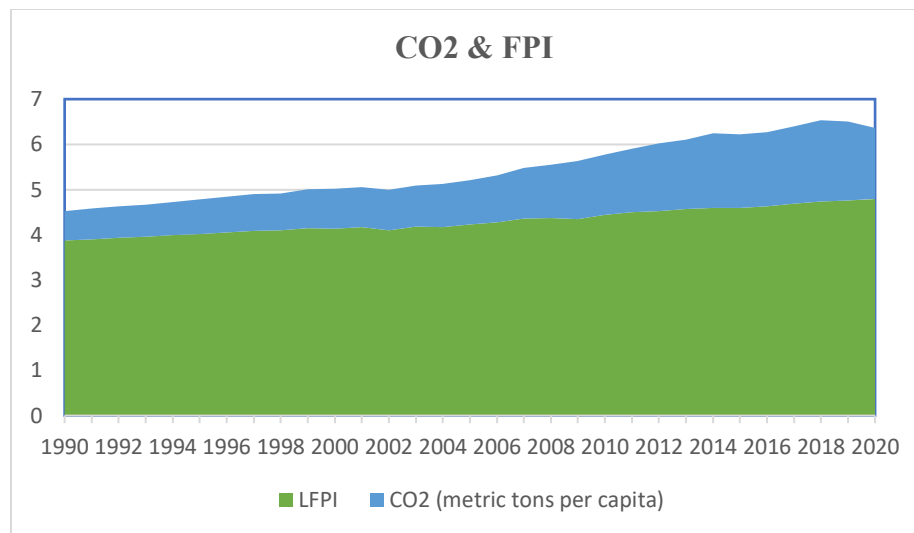


Figure 3(b) Carbon emissions and food production index

Food alone is responsible for around one-quarter (26%) of the world's GHG emissions. Further, increased pressure on land and water resources requires realignment of policies and resilient techniques. For this purpose, we took into account four variables: CO₂ emission, crop production index (CPI), food production index (FPI) and livestock production index (LPI), extracted from world development indicator (WDI) for the year 1990 to 2020. Carbon emission is taken as kg per

2021 PPP \$ of GDP, whereas production indices have the base year 2014-2016. The three panels of figure 1 attempts to demonstrate a relationship between carbon emission and production indices. The variables CPI, FPI and LPI show an increasing trend over the years supporting the need of growing population in India. Post - 2018 carbon emission shows a declining trend which can be attributed to an increase in sustainable food practices, keeping other variables constant.

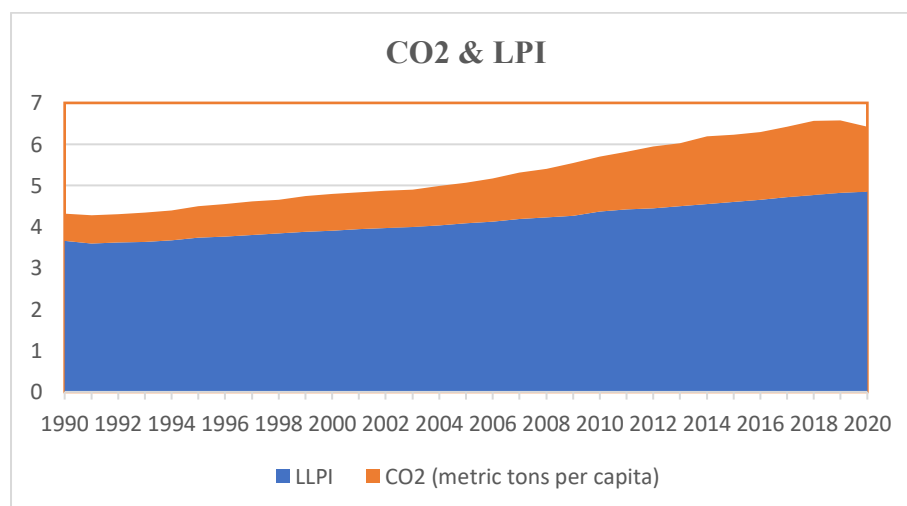


Figure 3(c) Carbon emissions and livestock production index

The following section will delve into explanation of scientific techniques, government schemes, and traditional practices that evolved overtime to ensure sustainability and combat climate change.

7. Techniques, Schemes, and Practices ensuring Sustainability

6.1 Scientific techniques

Over the years, various techniques have been evolved and discovered to reduce the effect of climate change and to ensure sustainability. Some of them are mentioned here as under:

- Some emerging irrigation system techniques, such as saturated soil culture, alternate wetting and drying, aerobic rice, drip, and sprinkler irrigation, are being reported to reduce water-use and increase water efficiency.
- Additionally, different agronomic techniques tailored to specific crops, such as aerobic rice, raised beds, and the system of rice intensification, are implemented to conserve water by adjusting tillage, irrigation amounts, crop planting, and the timing of water delivery. Saturated soil culture is another way of managing water resources.
- Crop cover is also important for ecosystem balance as it preserves soil from the erosion, improve its water availability, suppress weed, nutrient management in the soil etc. (Meyer et al. 2019).
- Another promising technique is nanotechnology. It plays an outstanding role in fostering sustainable development while handling with many alarming environmental issues like, wastewater treatment, bio-sensing, and bio fuel production. Conventional sources of energy like fossil fuels, which include coal and petroleum, are not able stand up to the mark of increasing energy demand. Further, the rising global warming due to rampant surge in CO₂ emission has become a grave

environmental menace. Increasing use of solar panels, wind energy and biomass energy is a major breakthrough in the process of cutting down GHG emissions.

- Bio energy is another wonderful alternative to tackle the issue of climate change as it is renewable, eco-friendly, and can create employment opportunities. Bio energy can also play a prominent role to improve the economic status of rural and backward areas through job creation. It could be employed to co-generate electricity as well as heat via combined heat and power (CHP) systems.

6.2 Government initiatives

There is plethora of government schemes and initiatives that addresses the issue of sustainability in different sectors of the economy. Some such schemes associated with our study are mentioned in this section.

- India's goal to achieve land degradation neutrality by 2030 by balancing any rise in land degradation with equal levels of land reclamation to prevent further depletion of natural capital.
- Government initiatives to ensure sustainable management of water and sanitation include Swachh Bharat Mission, Jal Jeevan Mission, National Rural Drinking Water Program, National Water Mission, etc.
- The National Mission for Sustainable Agriculture (NMSA) focuses on important aspects such as 'Water use efficiency', 'Nutrient Management' and 'Livelihood diversification' in agriculture industry. This can be achieved by transitioning to eco-friendly technologies, using energy efficient equipment, protecting natural resources, practicing integrated farming, etc. Other prominent agricultural schemes include, per drop more crop, agro-forestry scheme, Rashtriya Krishi Vikas Yojana (RKVY), etc.

- The energy sector is one of the top areas of research and debate. Energy serves as primary input in every productive process. Major schemes under energy sector include, PM KUSUM, PM Ujjwala Yojana, Rooftop Solar Program, Green Energy Corridors, Bio-energy program, National Green Hydrogen Mission, Solar Parks and Ultra-mega Solar Power Projects, and many more.

6.3 Traditional practices

One of the best ways to mitigate the effects of climate change, resource extraction, species endangerment, preservation problem, etc., is through traditional knowledge and practices. It turned out to be the oldest technique. Indigenous people or those who live in close contact with nature and its associated constituents are well aware of the changing climatic conditions. They develop their lifestyle according to the nature and adjust their rituals and habits (George, 2019). Their knowledge system contains a wide range of intellectual wisdom of varying generations and communities. Following is some of the strategies adopted as a measure to address the aforementioned issues:

- To address the issue of drought and flood, traditional people grow different varieties of crops and plants having varying degree of resistance to droughts and floods. They complement these activities with hunting, fishing, and collecting wild food plants.
- Another important traditional practice is water conservation technique. Some of the popularly used methods in India include, Bamboo Drip Irrigation, Bhandaras, Phad, Bandhas, Ramtek Model, etc., (Kumar, 2014).
- Social movements play a pivotal role in influencing humankind towards behavioral change. They help in supplying endemic solutions to aggravating social problems and

agricultural challenges cropping up due to climate change.

- International recognition to traditional practices and innovations began in 1960s. Culture and heritage aspect was addressed under UNESCO briefings. During 1980s, Food and Agricultural Organization (FAO) taken up the issues related to food security and initiated the necessary practices.
- In 1992, the Convention on Biological Diversity (CBD) was adopted. It greatly acknowledged the significance of traditional knowledge and associated practice.
- Development of national and state level policies, regulations and guidelines came into effect with due course of time to protect indigenous communities and inhabitants and their traditional knowledge and techniques through Intellectual Property Rights (IPRs). In India, the National IPR Policy (2016) was launched. It furnishes the scope of blending traditional knowledge with modern ideas in order to efficiently cope up the devastating effect of climate change.
- Institutional initiatives like The Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC) was created for the purpose of safeguarding indigenous knowledge and communities.

Furthermore, conservation and augmentation of indigenous knowledge and expertise; incorporation of formal and indigenous forms of knowledge system; training in traditional skills and generation of ‘knowledge banks’ of these skills (Nakashima, 2008); and energetic participation of NGO’s and general public in policy articulation pertaining to environment are some of the measures to ensure sustainability.

8. Greening of Institutions and Linkages under SCA

Under this section, we have come up with a novel idea of greening process of institutions. Many studies have highlighted the importance of ‘Green Finance’, ‘Green Museums’ or ‘Green GDP’ individually. However, our paper made a fair attempt to create a link between all of them, and how they impact each other. It reveals that museums are an important institution to put on green exhibits to portray different ways to adopt sustainable living using Smart Climate Approach, which we call here as ‘green museums.’

Further, green finance is described as an organized financial practice in the shape of a product aimed at sustainable development authorities. It consists of instruments such as green bonds, which are issued by sovereign entities, inter-governmental organizations, or corporations. These bonds are

designed for the purpose of funding environmentally sustainable projects. The term ‘Green GDP’, coined in the late 1980s, is calculated by subtracting the depreciation of produced assets from GDP, while also deducting the cost of natural resource depletion and ecosystem degradation.

The above diagram demonstrates the one-way and two-way links between the variables. Museums are the source of creation of knowledge and awareness about sustainability, environmental issues and climate change. Green museums educate about financing green projects, which in turn can lead to creation and financing of more such museums. Both green museums and green finance stands on the concept of sustainability. Further, the model establishes a two-way link between green finance and green GDP, which will create green economy and green societies.

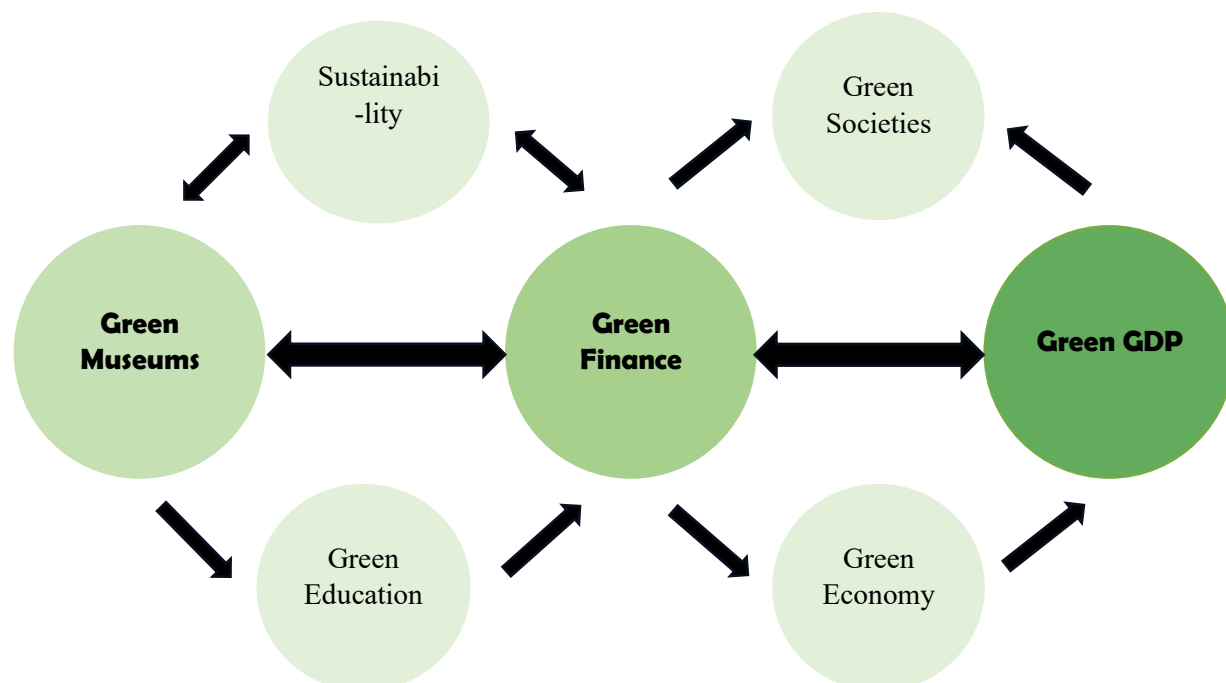


Figure 4 Process of greening of institutions (Source: Authors' preparation)

9. Result and Discussion

The thorough explorative study of resource-based environmental issues, resource depletion, carbon emissions and sustainable food provides a broader perspective to novel initiatives for environmental sustainability. The study brings forth a Smart Climate Approach to tackle the issue of sustainability, green economy and society. The results under section 6 demonstrate an increasing trend in production indices in line with growing population and carbon emission also kept on increasing till 2018 and started to decline thereafter, revealing food sustainability. Further, the study produces a linkage model for greening the institutions while keeping green museums and green finance at the center. The green museums like Regional Museum of Natural History, Bhubaneswar (Mahmood, 2022) and Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS), Mumbai are best examples in its drive towards sustainability. Green museums and green finance while standing on the pillar of sustainability, together creates environmental awareness and supports green societies and green economy.

10. Policy Suggestions under SCA

- a) **Connectivity and awareness:** The first and foremost step towards sustainability is awareness about emerging environmental issues and to enhance collective responsibility through connectivity to tackle it.
- b) **Networking Green Finance:** Finance is an important pillar in the performance of any activity. Opening up avenues to finance through green instruments is one such significant step. It will promote financing of green projects and activities from smaller to a larger scale in a comprehensive manner.
- c) **Incentives to Locals:** Local folklore live in the heart of India. Providing them incentives to promote green energy will not only lead to a cleaner surrounding but also serve them economically.
- d) **Bottom-up approach:** Switching to bottom-up approach in planning, management and organization of activities will result into greater success of programs, schemes, and missions that are rolled out to tackle environmental issues.
- e) **Schematic review of implementations:** Timely and sincere review of schemes and policies is another significant step to measure the accomplished targets set under the mission of sustainability. It will also help to fulfill unaccomplished ones via rolling out fresh initiative while looking into the limitations of previous. It is even better to focus on lesser schemes with sincere approach, rather than throwing up innumerable schemes, making the target unattainable.
- f) **School level smart climate activities:** Basic education starts from the school. It is much more worthy to inculcate smart climate activities into school curriculum or extra – curricular activities to explain its importance to children.
- g) **Exhibitions on smart climate:** Museums are an attractive venture which can be rightfully used in spreading knowledge among general masses and to create awareness among youth and children regarding small steps towards greening.
- h) **Emotional belonging:** Initiatives that bring resources, ecosystem and environment closer to our heart should be undertaken. Smaller and individual steps come from emotional attachment, which can emerge as an interesting step in this process.

Conclusion

The environment, which consists of different ecosystems, provides innumerable essential services. The resources that the environment offers are life enablers. Over rated depletion of these resources due to increased population pressure along with the derived demand has its adverse impact, namely, land degradation, poor soil health, water quality degradation, energy issues, and gaseous emissions. The paper made a good attempt to highlight food security in India, and how food production is associated with GHG emissions. The study highlights these issues along with the initiatives taken to combat climate change including, scientific techniques, traditional practices and government schemes. It also underlines the importance of institutions in the process of greening and provided a linkage model that adds up to the novelty of this article. The model rests on the principle of sustainability while inter-linking green museums, green finance and green GDP. In conclusion, we have provided certain policy suggestions under the SCA as a smarter step to ensure sustainability. The paper opens up avenues for future research in the area of greening of institutions as an emerging branch. The linkage model can further be elaborated for studies at various institutional levels.

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